Post-fire Site Rehabilitation: Final Report

Special Investigation

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Key Concepts and Terms

Armour: to protect erodible material using rock. For example, to rehabilitate a site where a machine crossed a stream, the stream banks may be armoured with rock to reduce erosion of the banks.

Berm: a mound of earth. The blade of a bulldozer often leaves a berm at the side of a trail.

Cross Ditch: a ditch excavated across the road at an angle and at a sufficient depth, with armouring as appropriate, to divert both road surface water and ditch water off or across the road.

Debris Flow: a mixture of soil, rock, wood debris and water which flows rapidly down steep gullies.

Erosion Control Blanket: a commercially available blanket made of biodegradable fibres and a biodegradable mesh that remains intact overtop an erosion-prone site until seed is established.

Fireguard: intended to stop or slow the spread of a fire, a fireguard may be built by hand or by machine. Fireguard construction can involve knocking down or falling trees, bulldozing the forest floor to expose bare soil, and crossing streams with heavy machinery.

Germination: to sprout or grow.

Hydrophobic Soils: when plant matter is burned during an intense fire, a waxy substance is released and it penetrates the soil as a gas. When the soil cools, this waxy substance hardens around soil particles and the soil becomes hydrophobic. Hydrophobic soils repel water and the amount of water that can infiltrate the soil is reduced.

Land Manager: an individual responsible for managing land, for example the Ministry of Forests district manager or a parks manager.

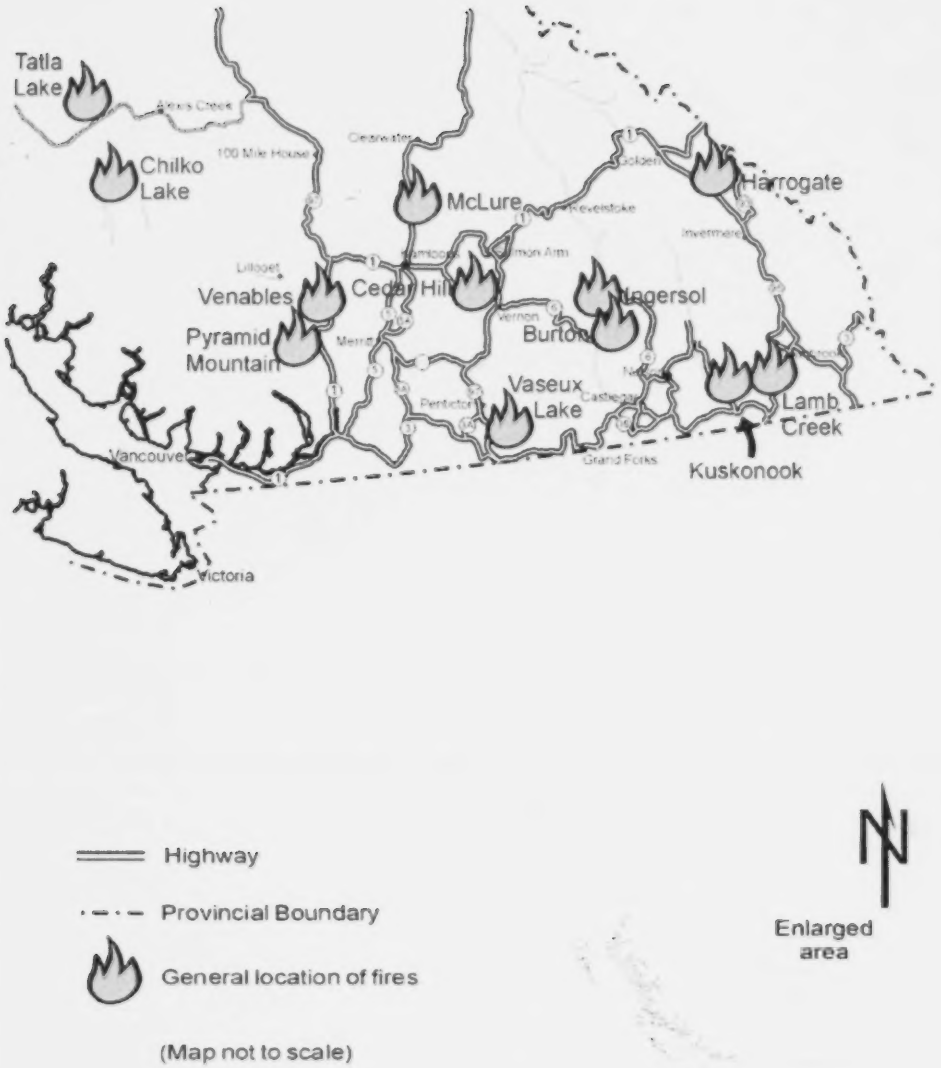
Slash: the residue left on the ground as a result of forest and other vegetation being altered by forest practices or other land use activities.

Sump: a reservoir used for storing water. Sumps are often constructed in streams and provide a source of water for a pump.

Waterbar: a shallow ditch dug across a road at an angle to prevent excessive flow down the road surface and erosion of road surface materials.

Willow whips: cuttings from willow trees.

Post-Fire Site Rehabilitation
Special Investigation
Sample Fires



Introduction

After experiencing the unprecedented 2003 fire season, most British Columbians are aware of government's role in fighting forest fires. However, the public may not know that after fires are out, significant work may be required to rehabilitate sites impacted by fire suppression activities.

The *Forest and Range Practices Act* (FRPA) permits the Forest Practices Board to conduct special investigations to determine compliance with FRPA, including the *Forest Fire Prevention and Suppression Regulation* (FFPSR). In light of the significant public interest in fire and its widespread impact, the Board decided to conduct a special investigation of post-fire site rehabilitation to fulfill its role as an independent public watchdog.

In early 2004, the Board began an investigation of post-fire site rehabilitation. The investigation considered whether:

1. comprehensive and effective rehabilitation plans are prepared for every fire where required;
2. FFPSR rehabilitation requirements are being implemented in the field; and
3. rehabilitation treatments are effective in controlling water and erosion.

The Board released an interim report in June, 2004, detailing the results of its review of fire rehabilitation plans[1]. The interim report concluded that the majority of plans were submitted to the designated forest official in accordance with the requirements of FFPSR subsection 36(3). The Board found there were legitimate reasons for not submitting the remaining plans for approval within the required timeframe.

FFPSR requires the person who carries out fire control or fire suppression operations to stabilize all fire access trails, fire guards and other fire suppression works to ensure that natural drainage patterns are maintained and surface soil erosion is minimized. To determine if these requirements were being implemented in the field, we visited a sample of fires. The Board also observed whether common rehabilitation treatments effectively managed water and controlled erosion. Treatments are considered to be effective if suppression works were stabilized, natural drainage patterns maintained and surface soil erosion minimized.

This report focuses on the field portion of the investigation.

Approach

Sample Selection

As noted in the interim report, 64 fires required fire rehabilitation plans. From this group, 12 fires were selected for investigation on the ground. The sample reflects a range of fire sizes and provides for geographic distribution. The rehabilitation plans varied in detail and complexity from two-page forms to binders of prescriptions, and the sample includes examples of both. The sample also includes fires that burned near urban areas (interface fires) and fires that affected community watersheds.

The sample is shown in the Table 1 and the approximate location of each fire is shown on the map on page 2.

Table 1: Fire Sample Selection

Fire Centre	Fire	Number	Fire Zone	Size (ha)
Cariboo	Chilko Lake	C50214	Chilcotin	29,201
	Tatla Lake	C50199	Chilcotin	1,867
Kamloops	Cedar Hill	K40300	Vernon	1,620
	McLure	K20272	Kamloops	26,345
	Pyramid Mountain	K70620	Lillooet	2,525
	Vaseux Lake	K50661	Penticton	3,300
	Venables	K20624	Kamloops	7,635
Southeast	Burton	N50451	Arrow	530
	Harrogate	N20289	Invermere	1,018
	Ingersol	N50617	Arrow	6,700
	Kuskonook	N70820	Kootenay Lake	4,839
	Lamb Creek	N10470	Cranbrook	11,882

Some fires were not included in the sample because rehabilitation work had not been completed at the time of the site visits in the spring and summer of 2004 (e.g., fires in the Columbia fire zone).

Fieldwork

Before each site visit, the Board reviewed the maps and plans for each fire and noted the features that could be impacted by fire suppression activities. Sites were prioritized to focus on those which posed the highest risk to forest resources. Examples of high-risk sites include sumps, stream crossings and fireguards constructed in steep terrain. Sumps and stream crossings are considered high risk due to potential harm to water quality, and fireguards constructed on steep terrain have potential to threaten human safety and, in some cases, could be a source of sediment to streams.

In most cases, the Board spent one day at each of the fires in the sample, accompanied by Ministry of Forests' protection staff and sometimes fire wardens and contractors. After an opening meeting with protection staff to confirm features and logistics, Board staff flew over the fire site in a helicopter. The overview flight was designed to confirm features and risks and to identify any other priority sites. The remainder of the day was spent on the ground at the higher-risk sites to confirm whether treatments were implemented as planned, and whether treatments were effective.

Observations

Before discussing the results of the field review, it should be noted they reflect observations made on the ground during a one-day field visit in the summer. There was little grass germination on some sites but we know grass successfully germinated later in the summer (through additional field observations or photographs provided by the Ministry of Forests). Also, debris flows did occur on some sites after the field visits. The debris flows are discussed later in this report.

The Board did not see every rehabilitation site for each fire, and in some cases rehabilitation was not complete at the time of the field visit. However, we gained a good understanding of the work that was done by focusing on high-risk sites. The overview flights also helped the Board to review the extent and quality of rehabilitation work quickly on lower-risk sites, such as rehabilitated fireguards on flat terrain.

Finally, the Board does not have jurisdiction to examine practices on private land and therefore did not view any private land rehabilitation.

Rehabilitation Treatments

The following section describes the standard rehabilitation treatments observed on the sample fires.

Fireguards and Trails

The treatments for rehabilitating fireguard and trails varied depending on the terrain, access considerations and, in one case, forest health risks.

For the majority of fireguards examined, the standard treatment was to pull back soil and slash, and to scatter slash, debris and downed trees onto the fireguard. Scattering slash on the fireguard creates microsites for seed germination and reduces surface soil erosion.

Erosion control blanket near Peterson Creek - McLure fire

Berms created by heavy equipment were breached and cross-ditches and waterbars installed to maintain natural drainage patterns and ensure the fireguards were stable i.e., resistant to erosion. Guards were seeded with grass.

On some steeper sites, prescriptions were prepared by professionals where necessary to guide rehabilitation. For example, on the McLure fire at Peterson Creek, a fireguard was constructed down a 60 percent slope perpendicular to the stream. An erosion control blanket was installed and the guard was seeded. The prescription was implemented effectively and the site was stable.

On flat ground where a fireguard was stable and natural drainage patterns were maintained, the only treatment may have been grass seeding. This was the standard treatment for the majority of fireguard at the Chilko Lake fire. However, preventing new access to fire sites was also a concern. Stakeholders in the Chilko Lake area were concerned about fireguards providing new access and the potential for increased hunting pressure. To address that concern, slash and debris were scattered across certain fireguards for up to 1 kilometre from road crossings to prevent new access.

At the Cedar Hill fire, slash on certain fireguards was piled and burned as soon as feasible to address concerns about Douglas-fir bark beetle and excessive slash accumulations. The beetles spend the winter under the bark and emerge in the spring to attack uninfested trees. One management technique is to burn infested slash before the beetles emerge in the spring.

Stream Crossings

Where trails and fireguards crossed streams, the general approach was to re-establish the stream banks, armour the banks with rock if required, and to revegetate the site with grass seed or willow whips. Trails were also decompacted on some sites. In special situations where streamside slopes were steep or the risk to water users and forest resources was high, specialists were employed to develop prescriptions and, in some cases, engineered designs to rehabilitate the site.

Armoured stream - Lamb Creek fire

Willow whip - McLure fire

Sumps, Staging Areas, Camps, Helicopter Landing Sites

The standard practice for rehabilitation of sumps was to fill the sump with the erosion-resistant material and to re-establish natural drainage patterns. Sites were then seeded.

Where staging areas, campsites or helicopter landing sites were established, the sites were recontoured and in some cases seeded with grass.

Rehabilitated fire campsite at Choelquoit Lake - Chilko fire

Results

During the office review of rehabilitation plans in early 2004, the Board noted the level of plan detail varied among fire sites. As a result, the Board considered whether each rehabilitation plan was appropriate for the rehabilitation work required to meet legislated standards. We also examined whether FFPSR rehabilitation requirements were implemented in the field and whether rehabilitation treatments were effective in controlling water and erosion.

Individual summaries for each of the fires sampled are contained in the Appendices. Overall, the Board found the level of detail within each rehabilitation plan appropriately specified the work required; FFPSR rehabilitation requirements were subsequently implemented in the field and rehabilitation treatments were effective in maintaining natural drainage patterns and minimizing soil erosion.

The Board noted a few examples where FFPSR requirements were not implemented in the field at the time of the site visits; however, those examples are minor given the scale of the 2003 rehabilitation program.

Debris Flows

Four debris flow events occurred after the site visits. The Board was interested to learn whether fire suppression activities or rehabilitation efforts were linked in any way to these events. MOF protection staff shared the same interest and arranged for specialists to review the events.

Cedar Hill

On June 25, 2004, an intense rainstorm contributed to debris flows that started within the Cedar Hill fire site. The debris flows blocked Highway 97 and required the evacuation of one residence.

A professional geoscientist visited the site and concluded suppression activities were not a contributing factor to the debris flows. The debris flows were caused by a short-lived and localized rainstorm that caused overland flow of water on steeper hydrophobic soils in intensely burned areas.

Vaseux Lake

On June 30, 2004, an intense rainstorm created severe runoff and caused erosion events at several locations along the slopes above Highway 97 beside Vaseux Lake. Private property was damaged and the highway was closed.

A professional engineer visited the site and reported no areas where fireguards impacted storm runoff. In fact, all fireguards were rehabilitated and revegetated very well. However, the engineer noted that pre-existing logging roads and trails in the area concentrated runoff and contributed to the damage.

Kuskonook

On August 6, 2004, a debris flow in Kuskonook Creek destroyed two homes, a garage and vehicles, and blocked Highway 3A north of Creston. A smaller debris flow occurred in nearby Jansen Creek. The debris flows began in the Kuskonook fire.

The professional engineer who prepared the rehabilitation plan identified the steep slopes above Kootenay Lake as having a moderate risk of debris slides and debris flows. The engineer considered the risk to life, property and the highway to be high and, as a result, ranked the area as high risk. Consequently, priority was given to rehabilitating suppression works on these slopes.

A professional geoscientist, professional agrologist and professional engineer from the southern interior forest region examined the site and concluded that, "the debris flows were caused by exceptionally high peak flow, generated by overland flow on hydrophobic soils."[2] Fireguards and other suppression works did not contribute to the initiation of the debris flow.

Lamb Creek

On August 19, 2004, a rainstorm contributed to a number of debris slides and debris flows within the Lamb Creek fire area. In particular, three debris slides occurred in the Gold Hill Creek drainage. The slides caused a dam to form at the confluence of Gold Hill Creek and Lamb Creek. When the dam broke, Lamb Creek flooded for 7 kilometres.

The professionals from the southern interior forest region[3] concluded the debris flows and flood were caused by the effects of hydrophobic soils resulting from the fire.

In summary, the debris flows and slides were not attributed to fire suppression or rehabilitation work undertaken at fire sites. It is worth noting that MOF protection staff were on site soon after the debris flows occurred to determine whether rehabilitation work contributed to the debris flows, and specialists were hired where necessary to determine the cause of the events.

Conclusions

The purpose of this special investigation was to determine whether the Ministry of Forests prepares fire rehabilitation plans when required, and if the plans are effectively implemented to ensure that suppression works are stable, natural drainage patterns are restored and surface soil erosion is minimized in accordance with FFPSR requirements.

During the investigation we met a dedicated team of government staff, fire wardens, consultants and contractors working under tight timelines to effectively implement rehabilitation plans. The scale of the rehabilitation work required after the 2003 fires was huge.

Thousands of kilometres of fireguard, trails and other suppression works were inventoried and mapped. Risk assessments were conducted to prioritize work based on the risk to human life,

forest resources and infrastructure. Specialists were employed to prepare prescriptions or engineered designs for sites that presented rehabilitation challenges or posed significant risk to the environment. First Nations, stakeholders and the public were often consulted during plan preparation. Contractors had to be hired and equipment secured to implement the plans before snow fell.

Of the 12 fires sampled, the Board found rehabilitation plans were effectively implemented and government generally complied with FFPSR rehabilitation requirements. The Board commends all those involved with the rehabilitation of the fires.

Update on Part One of the Investigation

During the office portion of the investigation, protection staff recommended that an individual be assigned the rehabilitation responsibility in the early stages of a fire. This would help reduce rehabilitation obligations and costs, as the rehabilitation coordinator could work with the incident command team to ensure the impact of fireguards and other suppression works was minimized. Equipment could also be coordinated and move seamlessly from suppression to rehabilitation.

On June 18, 2004, the Town Creek fire began approximately 5 kilometres northwest of Lillooet. Town Creek is a community watershed and it supplies the drinking water for Lillooet. Parts of the fire site are unstable. A rehabilitation coordinator was in place 10 days after the fire started and told the Board this approach made a difference. The coordinator gave an example involving a culvert that transferred drinking water from one side of a ridge to another. The plan was to build a fireguard across the culvert with a bulldozer, which would have destroyed it.

The rehabilitation coordinator recognized that when the culvert was replaced after the fire was out, 10 kilometres of road would have to be upgraded at significant expense to get equipment to the site. Instead, a geotechnical engineer and a hydrologist came up with a plan to build a log bridge over the culvert. After the fire was out, the bridge was dismantled and there was no impact to the culvert or water. This is an example of how thinking about rehabilitation during suppression can reduce costs and minimize impact to resources.

Recommendations

The Board makes the following recommendations based on its interim report and this final report.

Before a Fire

Fire Management Planning

Gathering information critical to the protection of forest resources and securing the agreement of the land manager on the general response to a fire will help to speed rehabilitation planning and implementation. For example, the land manager could provide the following information to MOF protection staff:

- sensitive areas where fireguards and access trails should not be built in a community watershed;
- areas where the creation of new access would be undesirable; and
- the appropriate grass-seed mix for a provincial park.

This information could then be considered to the extent possible when suppressing the fire.

The Board notes this will require the cooperation of the land manager.

Recommendation 1
Protection branch conduct fire management planning before the fire season begins and secure the agreement of the land manager on the general response to a fire.

Training

During the field portion of the investigation we saw examples of fireguards constructed in sensitive areas where there appeared to be a lower-impact alternative. Admittedly, it is easy to second-guess an operator who had to make a decision in an emergency situation. However, by thinking about rehabilitation during fire suppression, the impact on forest resources and the cost of rehabilitation can be reduced.

Recommendation 2
Protection branch ensure that staff and contractors working on fire suppression receive training to minimize the impact of suppression activities on forest resources.

Once a Fire Starts

Assignment of a Rehabilitation Coordinator

The assignment of an individual responsible for rehabilitation soon after the fire starts can reduce rehabilitation obligations and costs because rehabilitation can be considered during suppression activities and equipment can be coordinated more effectively.

Recommendation 3
Where warranted by the size of a fire and/or values at risk, incident commanders should assign an individual as rehabilitation coordinator as soon as possible.

After the Fire

Submission of Rehabilitation Plans

FFPSR requires a site rehabilitation plan be submitted to a designated forest official for approval if heavy equipment was used to suppress a fire. The plan must be submitted within 10 days of the fire being suppressed.

The interim report identified that 12 of 64 fire rehabilitation plans were not submitted within 10 days of fires being suppressed and, as a result, government did not comply with FFPSR section 36(3). However, the reasons for not complying were reasonable. While rehabilitation plans need to be prepared and implemented in a timely manner, the 10-day period appears to be arbitrary and should be revisited.

Recommendation 4
Government revisit the requirement to submit a rehabilitation plan to the designated forest official within 10 days of a fire being declared out.

The Board requests that the Ministry of Forests respond to these recommendations by December 31, 2005.

Grass Seed Guidelines

Seeding fireguards and other disturbed areas is a common fire rehabilitation practice. Deciding whether to seed and if so, reaching agreement on the appropriate seed mix and application rate with the land manager can take time and potentially delay the implementation of rehabilitation. Guidelines on the appropriate seed mix and application rate will expedite rehabilitation planning as seed mixes will not have to be negotiated for each fire. The Board is aware that grass seed guidelines are currently under development in the southern interior forest region. The Board supports this process and encourages the development of guidelines for other regions of the province.

Future Board Work

Debris flows occurred on 4 of the 12 fires that were examined in the investigation. Two of the debris flows destroyed homes and closed major highways. The debris flows were not attributed to fire suppression activities or rehabilitation efforts—they were caused by heavy rainstorms on hydrophobic soils.

There can be significant risk to life and infrastructure after fires. The Board plans to examine the process and responsibilities for identifying and managing risks to life, infrastructure and forest resources following forest fires. The Board expects to begin this work in the summer of 2005.

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[1] A copy of the interim report can be downloaded from the Board's website at: http://www.fpb.gov.bc.ca/SPECIAL/investigations/SIR10/SIR10.pdf.

[2] Peter Jordan P.Geo., Mike Curran, P.Ag. and Doug Nicol, P.Eng. 2004. "Debris Flows Caused by Water Repellent Soils in Recent Burns in the Kootenays" in *Aspect* (Newsletter of the Division of Engineers and Geoscientists in the Forest Sector), September 2004, pp. 4-9. [online] http://www.degifs.com/resources.php3?category=aspectnewsletter.

[3] A professional geoscientist, professional agrologist and professional engineer from the southern interior forest region examined the site.

Appendix A: Burton (Marshall Mountain)–Southeast Fire Centre

Overview

The Burton fire (N50451) burned approximately 530 hectares of Crown land on the east side of Lower Arrow Lake near Nakusp.

A rehabilitation plan was submitted on October 3, 2003. Rehabilitation included treatment of approximately 23 kilometres of fireguard. All of the fireguards were risk-rated and detailed prescriptions were prepared. The risk of surface soil erosion within the Snow Creek watershed was considered high. The watershed is used for domestic water purposes.

Board staff visited the fire on July 7, 2004.

Observations

The rehabilitation plan called for fire trails and guards to be stabilized, natural drainage to be restored and surface soil erosion to be minimized. All roads, guards and other disturbed areas were to be permanently deactivated unless they were required for salvage operations. Specific instructions were included in the detailed prescriptions.

We found that the plan was effectively implemented. Fireguards and trail were cross-ditched to maintain natural drainage patterns and coarse woody debris was scattered over exposed soil. Fill slopes were pulled back and sites were recontoured where necessary. We did not see any evidence of sediment delivery to Snow Creek.

Conclusion

Were comprehensive and effective rehabilitation plans prepared where required?

A comprehensive and effective rehabilitation plan was prepared for the fire.

Were FFPSR rehabilitation requirements implemented in the field?

FFPSR requirements were implemented in the field.

Were rehabilitation treatments effective in controlling water and erosion?

The treatments were effective in controlling water and erosion.

Appendix B: Cedar Hill–Kamloops Fire Centre

Overview

The Cedar Hill fire (K40300) is located next to Highway 97 near Falkland. It burned approximately 1678 hectares on both Crown and private land, and across a variety of tenures including a BC Hydro power line, a woodlot licence and a tree-farm licence. The terrain above Highway 97 is gullied and several residences are situated on the fans of the gullies. Some of these residents get their water from within the burned area.

A rehabilitation plan was prepared by October 10, 2003. The area was assessed by terrain and hydrology specialists, and the plan divided the fire into nine rehabilitation sections.

Not all rehabilitation work could be completed before snowfall, so an overview risk assessment was done to prioritize work based on the risk to down-slope resources. Potentially hazardous areas were identified and these were considered priority work sites.

Rehabilitation included treatment of approximately 120 kilometres of roads and trails. Work began in August 2003 and continued into the fall until snow fell in late November. Priority work sites were rehabilitated first.

During the spring of 2004, staff revisited the area to monitor the effectiveness of rehabilitation. Board staff visited the fire on May 28, 2004.

Observations

A concentrated network of fireguards and trails were built as part of fire suppression and some of those trails were suitable for use during timber salvage. As a result, not all trails were prescribed for rehabilitation before the winter. There is a risk in leaving trails untreated over the winter and that risk has to be balanced with the costs of treating a trail and then having a licensee undo that work to use the trail later.

Protection staff felt that there was a minimal risk in leaving some trails untreated over the winter especially on gentle slopes and benched sites. Protection staff explained that there was direct and frequent dialogue in the field between licensees and representatives of the land manager on this strategy.

Due to the presence of Douglas-fir bark beetle, slash and debris was not always redistributed on the fire guards. Where the beetle was a concern and where slash accumulation was excessive, slash was piled with the intent of burning it in the fall of 2004. On all fire guards, sufficient slash was left on the ground to create favourable microclimates, reducing surface soil erosion and maintaining habitat for small mammals.

Aerial grass seeding was completed during the last week of November, 2003. 774 hectares were prescribed and completed. Germination was generally patchy at the time of our site visit. However, by late July, grass was well established. In addition to the fire guards and trails, the Ministry of Forests seeded the steeper slopes within the burned area and the grass is thriving. Approximately 50 percent of the fire was seeded.

Sumps were dismantled and recontoured except where they were to be used for watering cattle. Stream and stream bank reestablishment was completed. Two stream crossings in the hydro line right of way required a second round of rehabilitation after four-wheel drive truck enthusiasts held a mud bogging event in the area. Rehabilitation was effective and noteworthy due to the amount of effort required to do so.

Where there were no plans for logging cuts and fills were re-established and natural drainage patterns were restored. Detailed prescriptions were prepared for each fireguard.

Conclusion

Were comprehensive and effective rehabilitation plans prepared where required?

A comprehensive rehabilitation plan was prepared for the fire. A reconnaissance and overview assessment was completed and it was used to guide rehabilitation plans and prescriptions. Specialists were used to prescribe measures to address high risk areas.

Were FFPSR rehabilitation requirements implemented in the field?

FFPSR requirements were implemented in the field.

Were rehabilitation treatments effective in controlling water and erosion?

The treatments were effective in controlling water and erosion.

Are there any outstanding issues?

The rehabilitation of the site has been and continues to be complicated by the salvage harvesting occurring under different licenses. As well all terrain vehicles and four-by-four enthusiasts are using the area. These uses have damaged some of the rehabilitation works, requiring follow up work.

Slash pile burning was completed by October 25, 2004.

In July, there was a sudden rainstorm in the Cedar Hill fire area which triggered a debris flow in the gullied terrain above Highway 97. Soil and sediment flowed down the gullies and settled on the highway.

Field investigation immediately after the event confirmed that the debris flow was not related to either fire suppression activities or rehabilitation work. The debris flows were caused by a short-lived and localized rainstorm that caused overland flow of water on steeper hydrophobic soils in intensely burned areas.

Appendix C: Chilko Lake–Cariboo Fire Centre

Overview

The 29,201 hectare Chilko Lake fire (C50214) was the second largest fire in BC in 2003. It is located southwest of Alexis Creek in the Brittany triangle. Small diameter lodgepole pine and Douglas-fir dominate the area. Fire has always played a role in defining this ecosystem. The fire burned approximately 90 percent of Nuntsi Provincial Park.

Rehabilitation began concurrently with firefighting in July and August 2003, and was substantially complete by mid-October. The area was grass seeded in late October 2003.

Board staff visited the site from June 1-2, 2004.

Observations

The rehabilitation prescription aimed to stabilize slopes and restore original drainage patterns. As the west Chilcotin plateau is so flat, no rehabilitation was required on many of the fireguards. However, sites with potential surface stabilization issues were identified and individual prescriptions prepared.

Slash was generally only distributed across fire guards where public access was a concern. Local residents and First Nations were concerned that the fireguards provided improved access into previously inaccessible areas. In response, protection staff attempted to block access along the fire guards by piling slash and woody debris on the fire guards for up to one kilometre from public access points. Despite these efforts, we saw evidence of mushroom pickers and recreation users circumventing the deactivation, mainly on all terrain vehicles.

Due to unstable soils and the presence of fish streams, two sites required engineered designs and received high priority. At one site a bulldozer built a fire guard down a 60 percent slope to the Chilko River, and at another site a bulldozer built fire guard down a 50 percent slope and crossed a stream twice. These sites were rehabilitated satisfactorily according to the engineered designs.

Fire guards were seeded but germination was non-existent at the time of our site visit. Follow-up tests of the seed showed it was viable so the seed was not the problem. Protection staff surmises that the lack of germination may be attributable to the displacement of the thin surface soil horizon during fireguard construction. The Chilcotin is very dry and natural grasses are quite patchy owing to the difficult growing site. The lack of grass did not affect the stability of disturbed sites. We saw little evidence of instability or erosion.

Conclusion

Was a comprehensive and effective rehabilitation plan prepared?

The rehabilitation plan was comprehensive and effective. Special attention was paid to sites where there were surface stability concerns, engineered designs were required, or access was a concern.

The public and stakeholders were invited to comment on the rehabilitation plan before it was implemented. Input was also sought from BC Parks, the Ministry of Forests, Aboriginal Affairs Branch, the Ministry of Transportation and Highways, the Department of Fisheries and Oceans and the Ministry of Water, Land and Air Protection.

Were FFPSR rehabilitation requirements implemented in the field?

FFPSR requirements were implemented in the field. The plan was effectively implemented.

Were rehabilitation treatments effective in controlling water and erosion?

The treatments were effective in controlling water and erosion. Slopes were stabilized and erosion controlled.

Are there any outstanding issues?

The fire guards and trails were grass seeded but the seed did not germinate. The majority of the burned area is flat and the establishment of grass may not necessarily aid in site stabilization. There are a limited number of areas with steep slopes near streams that should be monitored to see if re-seeding is necessary. At the two priority sites where engineered designs were required, hydroseeding was done and grass establishment was not a concern.

According to Protection staff, addition work was completed on fireguards in September 2004 to prevent vehicle traffic from breaching cross ditches leading into Brittany Lake. Access that had been opened by mushroom pickers was also closed and slash placed on the fireguard.

Appendix D: Harrogate–Southeast Fire Centre

Overview

The Harrogate fire (N20289) burned approximately 1,018 hectares in mountainous terrain west of Highway 95 about 60 kilometres north of Invermere.

A rehabilitation plan was prepared and submitted on October 16, 2003. Approximately 10 kilometres of fire guard were scheduled to be rehabilitated. An archaeological field reconnaissance assessment and an engineering assessment were carried out and the rehabilitation plan reflected the recommendations where applicable.

Board staff visited the site on July 14, 2004.

Observations

The fireguard rehabilitation prescription called for stabilizing and recontouring slopes and distributing slash and large woody debris over the guard surface. The prescription also called for natural drainage to be maintained or restored, including the installation of waterbars on steep sections of guard.

Fireguards were recontoured, stabilized, and slash was distributed across the surface. We viewed a site where a temporary bridge had been installed but had since been removed. Natural drainage was maintained at the site as it was throughout the fire.

The fire burned up over the height of land and down into the Beaverfoot drainage. Rehabilitation work in the Beaverfoot drainage was not completed before winter set in. However, temporary deactivation of fireguards was completed and we observed that the cross ditches and waterbars held up over the winter and water and erosion was effectively controlled.

We also viewed a retardant mixing site (mud pit) in the Beaverfoot drainage and it was effectively rehabilitated.

Conclusion

Was a comprehensive and effective rehabilitation plan prepared for the fire?

A comprehensive and effective rehabilitation plan was prepared.

Were FFPSR rehabilitation requirements implemented in the field?

FFPSR requirements were implemented in the field. The plan was effectively implemented.

Were rehabilitation treatments effective in controlling water and erosion?

The treatments were effective in controlling water and erosion. Fireguards were stabilized and erosion controlled.

Appendix E: Ingersol–Southeast Fire Centre

Overview

The Ingersol fire (N50617) burned approximately 6,700 hectares of Crown and private land on the west side of Lower Arrow Lake near Nakusp.

A rehabilitation plan was submitted on September 16, 2003. Rehabilitation included treatment of approximately 20 kilometres of fireguard.

Board staff visited the fire on July 7, 2004.

Observations

The rehabilitation plan called for fire guards to be stabilized. Most were low impact, ridge-top fire guards, or guards beside roads. Some sections ran through plantations. The guards were cross-ditched to maintain natural drainage patterns. We saw no evidence of grass seeding or pullback of coarse woody debris, although there was no coarse woody debris in the plantations. There were no impacts with the following exception.

On Stevens Road, fireguard was built immediately beside the road. The road had been marked for cross-ditching as part of rehabilitation, however it was missed. The result was that water ran down the road causing severe channelized erosion from 15 to 120 centimetres deep for a distance of approximately 300 metres. The soil consists of soft sands and most was deposited on a bench however 10 percent of the coarse material and 90 percent of fine materials reached an S3 stream. The site had not been seeded.

Protection staff had not visited the site in 2004 so it was the first time they were aware of the problem.

Conclusion

Were comprehensive and effective rehabilitation plans prepared where required?

The rehabilitation pian for Crown land was brief, but it was suitable considering the work that was required.

Were FFPSR rehabilitation requirements implemented in the field?

FFPSR requirements were implemented in the field with the exception of the Stevens Road site.

Were rehabilitation treatments effective in controlling water and erosion?

The treatments were effective in controlling water and erosion.

Are there any outstanding issues?

On January 17, 2005, protection branch provided photos of work that they did to address the Stevens Road site. During the summer of 2004, the road was re-established and waterbars were installed.

Appendix F: Kuskonook–Southeast Fire Centre

Overview

The Kuskonook fire (N70820) burned approximately 4,839 hectares on the east side of Highway 3A north of Creston. The fire burned at elevations between 550 and 2,100 metres. Values in the area of the fire included the Sanca Creek community watershed, domestic water intakes, mineral claims, private land and tenured forest land.

A professional engineer prepared a rehabilitation plan and submitted it on October 9, 2003. Rehabilitation included treatment of approximately 90 kilometres of fireguard.

Board staff visited the fire on July 8, 2004.

Observations

Due to the high elevation of the site and the imminent onset of winter, a risk assessment was performed to prioritize sites for rehabilitation. Where work could not be completed by winter, temporary deactivation was done to guards and trails to minimize erosion.

The soil is made up of sand and gravel so control of surface erosion was a key element of the rehabilitation plan. The plan called for fire guards and trails to be stabilized, natural drainage patterns to be maintained and surface soil erosion to be minimized. In practice, this involved the installation of waterbars, cross ditches and swales to maintain natural drainage. For fireguards, this meant pulling back side cast, recontouring slopes, and redistributing slash to ensure that sites were stable. Where impacted by fireguards, stream banks were re-established and armoured.

Generally we found that treatments prescribed in the rehabilitation plan were effectively implemented. At the time of our site visit, the plan was implemented with the exception of grass seeding. Aerial seeding was completed in July, after our site visit.

We did see an example of a rehabilitation challenge created by a fireguard built through a stream. At the SA 28 crossing site, fireguard was constructed across a S4 tributary to Sanca Creek. Soils are sandy at this site. The cut slope and fill slope were pulled back but this treatment was only partially effective as sand raveled down into the stream for approximately 20 metres.

Update

In late September 2004, the Forest Practices Board audited a licensee whose operating area included the Kuskonook fire. The licensee was concerned that deactivated roads had been opened up during fire suppression but had not been returned to their original state after the fire

was suppressed. Through our fieldwork, we also discovered a sump that had not been rehabilitated (bridge C-18, 17.9 km Sanca south fork) and a reconstructed water crossing (culvert CU-12, Jackladder) that was contributing sediment to a stream. These sites were not included in the rehabilitation plan. Although the work that was prescribed in the rehabilitation plan had for the most part been implemented, it became clear that the plan itself did not include all of the work that was required.

Protection staff explained that complete maps were not provided to the consultant who prepared the plan and as a result some work that should have been done was not included in the plan.

Licensee and protection staff met on November 17, 2004 to identify the sites that require rehabilitation. Protection staff committed to revisiting the sites in the spring of 2005, developing plans and completing the work that is required.

Conclusion

Were comprehensive and effective rehabilitation plans prepared where required?

A rehabilitation plan was prepared for the fire; however it did not include all of the sites that required rehabilitation. The rehabilitation treatments that were included in the plan were effectively implemented. Protection staff plan to visit the sites that were missed and complete the work required in the spring of 2005.

Were FFPSR rehabilitation requirements implemented in the field?

FFPSR requirements were implemented in the field with the exception of the sites mentioned above. Rehabilitation work will be completed in the spring of 2005.

Were rehabilitation treatments effective in controlling water and erosion?

The treatments were effective in controlling water and erosion.

Appendix G: Lamb Creek–Southeast Fire Centre

Overview

The Lamb Creek fire (N10470) is centered about 20 kilometres southwest of Cranbrook off Highway 3. This was one of the largest fires in our sample at approximately 11,882 hectares. The area has a developed road system and a long history of harvesting.

Rehabilitation plans were submitted to the Ministry of Forests, Southeast Fire Centre in November 2003. Due to its size, the fire was divided into four zones. Rehabilitation involved treatment of approximately 300 kilometres of guards, 20 sumps or waterholes, 6 major stream crossings and 10 minor stream crossings. The plan called for aerial seeding of 600 hectares.

Two trails were constructed in unstable terrain. Terrain stability assessments were completed for these sites before rehabilitation was done.

The traditional use of the fire area by First Nations required that attention be paid to cultural heritage values. Some sites required archaeological impact assessments (AIA) and rehabilitation staff ensured that work was not carried out until the AIAs were available.

Rehabilitation work began while the fire was still active continued until winter. Areas identified as high risk were addressed first.

During the spring of 2004, rehabilitation staff revisited the area to gauge the effectiveness of their treatments.

Board staff visited the fire on July 13, 2004.

Observations

The fire burned late in the fire season and rehabilitation was underway even before the fire was out. As a result, some rehabilitation work was done before plans were approved. In addition, plans for salvage harvesting were not finalized which meant that some trails were rehabilitated only to be re-established when salvage harvesting began. Some coordination was possible though, and one road was not permanently deactivated to allow for a licensee to haul timber on it.

The treatment prescribed for fire guard rehabilitation was to decompact trails, re-contour slopes, re-establish natural drainage, and scatter slash over exposed soil. Guards were then seeded. Germination was generally patchy however it was still early in the season.

All sumps were dismantled, re-contoured and stabilized with one exception--a family of marmots took up residence in the rocks beside a sump and rehabilitation staff chose not to disturb them.

Stream bank reestablishment was completed where required. McNeil Creek required an engineered design to re-establish the stream bank where it had been crossed by bulldozers. Stabilizing logs were implanted in the bank, the bank was recontoured and willow whips were planted.

At Gold Hill Creek we noticed sediment entering the creek. However, the source of the sediment was from an adjacent salvage harvesting operation, and not due to a lack of rehabilitation.

Cuts and fills were re-established and natural drainage patterns were re-established.

Update

According to Protection staff, rain in July and August aided grass germination on fireguards. Mushroom pickers on all terrain vehicles used rehabilitated fire guards for access. Seedbeds were disturbed, and litter was also an issue.

Conclusion

Was a comprehensive and effective rehabilitation plan prepared for the fire?

The rehabilitation plan was comprehensive and effective. Specialists were used to prescribe treatments on high risk areas.

Were FFPSR rehabilitation requirements implemented in the field?

FFPSR requirements were implemented in the field. The rehabilitation plan was effectively implemented.

Were rehabilitation treatments effective in controlling water and erosion?

The treatments were effective in controlling water and erosion. Slopes were stabilized and erosion controlled.

Appendix H: McLure–Kamloops Fire Centre

Overview

The McLure fire (K20272) burned over 26,000 hectares of Crown and private land in the Barriere and Louis Creek area north of Kamloops.

A five-person team directed rehabilitation. A rehabilitation plan was prepared by October 30, 2003. 35 prescriptions were produced to guide rehabilitation around streams and lakes. These sites were given high priority for rehabilitation. Rehabilitation staff consulted with the Department of Fisheries and Oceans and the Ministry of Water, Land and Air Protection on problem areas and rehabilitation plans.

Rehabilitation included treatment of approximately 375 kilometres of fireguard. Work began in September while the fire was still burning, and continued into late November. Aerial seeding was done during the last week of November.

Board staff visited the fire on May 26, 2004.

Observations

Fireguard was built through standing timber, plantations and alongside roads. Rehabilitation treatments varied depending on the site however all included restoring natural drainage patterns and ensuring that the site was stable. On guards wider than 5 metres, slash was redistributed over the site.

Steep slopes (greater than 35 percent) were recontoured and water-barred to restore natural drainage and ensure stability. Steeper slopes were rehabilitated by hand.

Where fireguards crossed streams, material was pulled back, the banks were re-established and armoured where necessary, and exposed soil was either seeded or planted with willow.

At Allan Lake, a 100 metre wide fire guard was built on a 15 percent slope for approximately 350 metres right to the shoreline. Approximately 115 metres of the riparian management area of an S4 fish stream was impacted. Rehabilitation at this site was only 50 percent effective in our opinion because there was no vegetation on the guard and it remained a sediment source for the stream and the lake. The site is so large it resembles a cutblock and should be revegetated.

At Peterson Creek, a bulldozer constructed guard down a 70 percent slope above a domestic water intake. A rehabilitation prescription called for the installation of an erosion control blanket on the slope and seeding. The prescription was implemented and we found the treatment to be very effective. Slash was pulled back and scattered and the erosion control

blanket was installed. The site was then seeded and we saw good germination at the time of our visit.

Update

Protection staff re-visited the Allan Lake site in October 2004 and noted scattered grass germination. They re-seeded the bare patches and expect germination in spring 2005.

Conclusion

Was a comprehensive and effective rehabilitation plan prepared where required?

A comprehensive and effective rehabilitation plan was prepared for the fire. 35 prescriptions were prepared for higher-risk riparian areas.

Were FFPSR rehabilitation requirements implemented in the field?

FFPSR requirements were implemented in the field. The rehabilitation plan was effectively implemented.

Were rehabilitation treatments effective in controlling water and erosion?

The treatments were effective in controlling water and erosion.

Appendix I: Pyramid Mountain–Kamloops Fire Centre

Overview

The Pyramid Mountain fire (K70620) burned approximately 2,525 hectares west of the Trans-Canada Highway north of Boston Bar. The fire burned in mountainous terrain away from populated areas.

A rehabilitation plan was prepared and submitted on September 30, 2004.

Board staff visited the site on May 19, 2004.

We selected this fire for sampling because of its geographic location, but also because the rehabilitation plan was four-pages long, and we wanted to test whether or not the plan was appropriate for the fire.

Observations

The prescription for fire guard rehabilitation was to deactivate, recontour and redistribute slash on guards. One section of fireguard was built on the rocky and treeless crest of a ridge, following an old mining trail. The impact of the fireguard was minimal as was the effort required for rehabilitation.

Other guards were constructed through forest and slash and coarse woody debris was scattered over the guard, consistent with the prescription.

The prescription also called for natural drainage to be maintained by stabilizing water crossings and that was done according to the prescription. Roads were also deactivated except for those still in use by a mining operation.

Conclusion

Were comprehensive and effective rehabilitation plans prepared where required?

The rehabilitation plan was suitable for the work that was required.

Were FFPSR rehabilitation requirements implemented in the field?

FFPSR requirements were implemented in the field.

Were rehabilitation treatments effective in controlling water and erosion?

The treatments were effective in controlling water and erosion. Fireguards were stabilized and erosion controlled.

Appendix J: Tatla Lake–Cariboo Fire Centre

Overview

The Tatla Lake fire (C50199) burned approximately 1,875 hectares beside Highway 20 west of Puntzi Lake. The area's forest is dominated by small diameter lodgepole pine and Douglas-fir, and is relatively flat with the exception of some steeper terrain near the shore of Tatla Lake. An engineering officer from the Chilcotin forest district visited the site and prepared a rehabilitation plan in July 2003. Rehabilitation work was completed by the fall and the area was grass seeded in late October 2003.

Board staff visited the site on June 1, 2004.

Observations

The prescription for fire guard rehabilitation was to re-establish natural drainage patterns, prevent erosion of the area's highly erodible soils, and to distribute slash on the guard to impede access by all terrain vehicles while still providing openings for cattle and wildlife movement. Seeding of all exposed mineral soil was also required.

Like the Chilko Lake fire, there was not a large amount of slash to redistribute, especially when the guards ran through cutblocks. Available slash was redistributed on the fireguards and cross ditches were installed where necessary to restore natural drainage patterns and to mitigate surface erosion, consistent with the prescription. Berms created by the fireguards were recontoured.

The fire guards were seeded with grass but at the time of our site visit, very little seed had germinated. Like the nearby Chilko Lake fire, the lack of grass did not affect the stability of disturbed sites. We saw little evidence of instability or erosion.

Conclusion

Were comprehensive and effective rehabilitation plans prepared where required?

The rehabilitation plan was suitable and effective for the rehabilitation work that was required.

Were FFPSR rehabilitation requirements implemented in the field?

FFPSR requirements were implemented in the field.

Were rehabilitation treatments effective in controlling water and erosion?

The treatments were effective in controlling water and erosion. Fireguards and slopes were stabilized and erosion controlled.

Are there any outstanding issues?

Further monitoring will be required to determine if additional seeding is required, especially near the shoreline of Tatla Lake.

Appendix K: Vaseux Lake–Kamloops Fire Centre

Overview

The 3,300 hectare Vaseux Lake fire (K50661) is located south of Penticton, east of Highway 97. A rehabilitation plan was prepared by November 12, 2003, and rehabilitation took place during October and November. Rehabilitation included treatment of approximately 50 kilometres of fireguard.

The district range officer provided a prescription and seed mix recommendations for the fire guards

Board staff visited the fire on May 27, 2004.

Observations

The prescription for fire guard rehabilitation called for stabilizing or restoring guards by levelling the overburden, recontouring, cross ditching, revegetating and closing access.

Typically the guards were recontoured and slash was redistributed. Natural drainage patterns were restored. The guards had been seeded and germination was observed at the time of our visit. Overall, rehabilitation of the guards was effective.

The rehabilitation plan called for water crossings to be stabilized and restored. We found that where fire guards crossed streams, banks were restored and exposed soil was seeded.

Conclusion

Were comprehensive and effective rehabilitation plans prepared where required?

The rehabilitation plan was two-pages long, but it was suitable for the work required.

Were FFPSR rehabilitation requirements implemented in the field?

FFPSR requirements were implemented in the field.

Were rehabilitation treatments effective in controlling water and erosion?

The treatments were effective in controlling water and erosion.

Appendix L: Venables–Kamloops Fire Centre

Overview

The Venables fire (K20624) is located south of Ashcroft on the west side of the Trans-Canada highway. The fire burned approximately 8,322 hectares on Crown and private land, in Cornwall Hills Provincial Park and on Indian reserve land.

The fire burned actively until mid-November, but rehabilitation began on September 16, 2003. The rehabilitation plan was submitted on October 21, 2003. Rehabilitation involved treatment of approximately 150 kilometres of fire guards. Work stopped in mid-November due to snow. Cornwall Hills Provincial Park is located in the upper elevations of the fire. Priority was given to deactivating fireguards and trails in the park before snowfall. Work then continued at lower elevations.

Four First Nations have interests in the area. Due to the likelihood of impacts to cultural heritage values, an archaeological field reconnaissance was completed by a consultant. The study identified where rehabilitation activities could take place and where further investigation was required before work was done.

Board staff visited the fire on May 25, 2004.

Observations

The rehabilitation prescription for fireguards called for stabilizing sites and revegetating exposed soil, pulling soil and debris back onto guards and redistributing slash and large woody debris. Any berms that were created by bulldozers were to be pulled back and recontoured.

At the first site, we discovered a 350 metre section of guard that had not been rehabilitated (section B8). It appeared that it had been missed since other work was done nearby. Grass seed had germinated on approximately 25 percent of disturbed areas. Cross ditches were frequent however some were angled in the wrong direction.

At the second site (B7A), a bulldozer built fireguard down a 60 percent slope in gullied terrain, exposing soil and causing sedimentation into a non-classified drainage. No rehabilitation was done with the exception of small, hand dug cross ditches. Above that site, a guard was built across the slope, but the fill slope had not been pulled back. We saw little evidence of grass germinating in this area. Seeding was done during drought conditions and that may explain the poor germination. This site would be very difficult to rehabilitate due to the slope and erodible soils. It provides an example of an area where a fireguard would probably not have been built if the machine operator had rehabilitation in mind.

Fireguard was built in the alpine of Cornwall Hills Park. Felled trees were placed over the guards and rehabilitation was excellent. A seed mix was agreed upon with BC Parks and the site was seeded, but we did not see much evidence of germination. This is likely explained by the timing of our site visit and the elevation of the park.

Fireguards in the north part of the fire were built along side existing logging roads and through cutblocks. Salvage harvesting was ongoing. Guards in this section were deactivated according to prescription.

The prescription for watercourses crossed by guards and trails called for re-establishing natural drainage patterns. Streams were cleaned of debris and natural drainage patterns were restored. Finally, we viewed a deactivated sump. The sump was effectively deactivated according to prescription and the site was stable.

Update

Protection staff returned to sites B7A and B8 on October 20, 2004. A moist summer encouraged grass germination and only a few bare spots were noted. Staff seeded the bare areas and provided pictures to the Board. Staff also manually constructed a cross ditch on the B8 fireguard to improve drainage.

Conclusion

Were comprehensive and effective rehabilitation plans prepared where required?

The rehabilitation plan was comprehensive and effective.

Were FFPSR rehabilitation requirements implemented in the field?

FFPSR requirements were implemented in the field with the two exceptions noted above. These exceptions made up a very small percentage of the rehabilitation work undertaken.

Were rehabilitation treatments effective in controlling water and erosion?

The treatments were effective in controlling water and erosion. Slopes were stabilized and erosion controlled.